



Why is There Such a High Level of Nitrogen Dioxide at the Entrance to Our School?

Thomas Eve & Kilian Mangan
The King's Hospital

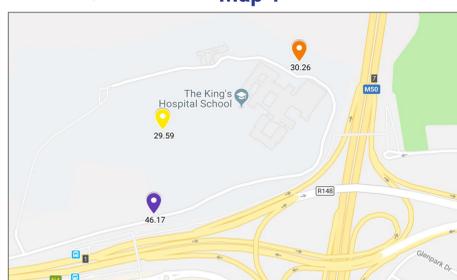


Introduction

When we received the results from the Environmental Education Unit's analysis of Irish school's air quality testing, we were shocked to discover that our school had the highest nitrogen dioxide (NO₂) concentration, with one reading of 46.17µg/m³ [Map 1] (described as Very Bad by the air quality scale. [Graph 3])

A total of 36 schools participated in the test. They were from all over Ireland and ranged from being located in rural areas to being in Dublin city centre.

Map 1



NO₂ can inflame the lining of the lungs making respiratory diseases worse. It can also cause wheezing, coughing and bronchitis and increases the likelihood of developing respiratory diseases such as asthma.

When we learned that we had some of the worst air quality in the country, we were eager to find out the cause of the problem. At first glance, our school is in an ideal location. It is an 85-acre greenfield campus 20 minutes outside of Dublin City. However, the school borders the M50 motorway and the N4 dual carriageway.

We decided to delve in deeper and we started asking some tricky questions that we didn't know the answers to.

Research Questions

We wanted to know the answers to the following questions:

- Why is there such a high level of NO₂ at the entrance to The King's Hospital?
- Why is the NO₂ concentration very high away from the main road?
- Why was our reading at the front gate the highest in the country?
- Looking at other schools, are there high NO₂ levels beside moving traffic?

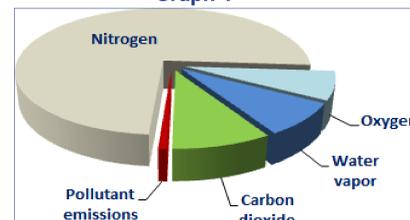
Research Methods

To answer the question 'Why is there such a high level of NO₂ at the entrance to The King's Hospital?', we had to find out what actually comes out of the exhaust of a car. We found that almost 75% of diesel car and bus emissions are NO₂ [Graph 1].

Looking even further into the matter, we realised that there is also a busy bus stop situated 50 metres from the school gate.

Without a doubt, this constant stopping and starting of vehicles contributes hugely to the high readings around our school.

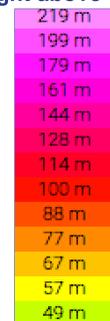
Graph 1



To answer the question 'Why is the NO₂ concentration still very high away from the main road?' we first had to realise that the school is located on a minor road parallel to the N4 dual carriageway. We found that, during February, when daytime temperatures average 10°C in Dublin, NO₂ is far heavier than air.

NO₂ has a density of 1450 kg/m³ whereas air at 10°C has a density of 1.225 kg/m³.

Height above sea level



Map 2



Using a topographic map, we discovered that there is a downward slope from the main road to the school. This gradient means that the NO₂ from the nearby motorway and dual carriageway rolls down the hill and sits in the school grounds, like it's trapped at the bottom of a pit, thus making the NO₂ concentration high. [Map 2] The school is marked with an X.

Results

We discovered that, for most vehicles, idling (the act of keeping an engine running slowly while the car is stationary) for more than 10 seconds releases more CO₂ than stopping and restarting your car. However, NO₂ emissions are higher from stopping and starting rather than idling.

At the entrance to The King's Hospital, the gate is only wide enough to allow one car to go through at a time. As a result of this, people stop their cars while waiting for other cars to pass through the gate. This cycle of cars stopping and starting their engines reflects the amount of NO₂ being released into the air.

This is most likely the main reason that there is such a high level of NO₂ in the air around the entrance to the school.

Graph 2

Difference in Concentration Between Locations Around the Schools



Graph 3

After analysing the nationwide results, we found that in almost every school across the country, NO₂ concentration is higher beside moving traffic compared to a sheltered area eg. a location just outside the school building. [Graph 2] We used Graph 3 to help us analyse the data which can be seen on the vertical axis on Graph 2.

NO ₂ concentration (µg/m ³)	Description
50 +	Extremely bad
45 - 50	Very bad
40 to 45	Bad
35 - 40	Substandard
30 - 35	Mediocre
25 - 30	Average
20 - 25	Pretty good
15 to 20	Good
10 to 15	Very good
0-10	Excellent

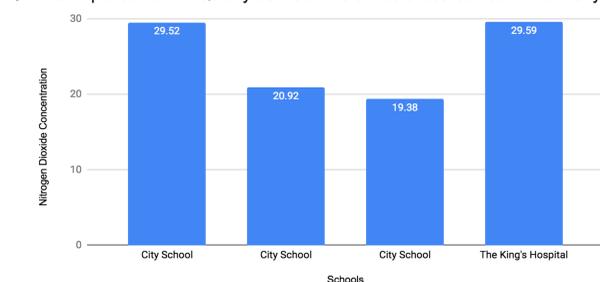
Discussion

We believe the reason The King's Hospital has the highest reading in the country is because:

- Cars must stop at the front gate
- It is located beside two of the busiest roads in the country
- It is close to a commuter bus stop
- It sits at the bottom of a slope

The King's Hospital's results for NO₂ levels at moving traffic is higher than the other three schools located near Dublin city. [Graph 4]

A Comparison of Air Quality between the schools located near Dublin City



Conclusions

- From our research we have discovered that NO₂ has a much higher concentration beside the entrance to the school because cars frequently stop and start here, producing emissions.
- To reduce the amount of NO₂ being emitted at the gate of the school we could remove the gate or make it wide enough to allow cars coming from each direction to pass each other. This would eliminate the need for cars to have to stop at the gate, reducing the quantity of negative gases being released into the air.
- To expand on this project we would consider testing other gases that are found in the air like carbon or sulfur oxides. We would also be interested to find out the time of day of peak NO₂ emissions, and is it linked to school peak traffic times and/or rush hour?
- We would consider informing the school body about the results and encourage them to walk, cycle, carpool or take the bus.

Bibliography

- <https://www.epa.gov/no2-pollution/basic-information-about-no2> 15/4/19
- <https://www.environment.gov.au/protection/publications/factsheet-nitrogen-dioxide-no2> 15/4/19
- https://afdc.energy.gov/files/u/publication/which_is_greener.pdf 15/4/19
- <https://www.google.com/maps/> 28/4/19
- <http://en-ie.topographic-map.com/places/Dublin-2520/> 28/4/19

